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Fire Blight of Pear and Apple

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INTRODUCTION

Object of this Circular

Fire Blight, the most dreaded disease of the pear and apple has been somewhat prevalent in certain sections of Oregon for several years. On account of the importance of the disease, particularly in a fruit-growing state, and the fact that most of the reliable information so far published concerning it is out of print, or at least not readily obtained by our orchardists, it has seemed desirable to issue a circular of information from the Oregon Experiment Station, giving as briefly as possible the essential facts concerning the cause and method of eradication of the disease.

The fact that this circular is issued at this time should not be taken as an indication that the disease is spreading to any alarming extent. As is well known, Fire Blight is prevalent in Southern and Eastern Oregon. In Western Oregon it has been reported as far north as Roseburg and it may spread into the Willamette Valley at any time. Reliable information is lacking concerning the extent of infection in Eastern Oregon. It is important that every orchardist should familiarize himself with the symptoms and method of eradication so that as soon as the disease appears in any locality it may be promptly recognized and stamped out so as to reduce to a minimum the possibility of its obtaining a foothold in uninfested localities, or spreading to any alarming extent.

It is not the intention in this circular to present anything new in regard to Fire Blight. The writer has had an opportunity to study Fire Blight as it occurs on the pear and apple in Delaware, New York and more recently in Oregon. In preparing this circular, however, the writer has drawn freely on the best available literature on the subject. The papers which have been most helpful are those of Waite* and Whetzel**, to whom acknowledgement is here given.

Thanks are due the New York (Cornell) Station for the use of cuts for figures No. 1, 2, 3, 4, 8.

*Waite, M. B. Pear Blight and Its Control in California. Report 31st Fruit Growers' Convention of the State of California pp. 137-155 1906.

**Whetzel, H. H. The Blight Canker of Apple Trees. Bul. N. Y. (Cornell) Station, No. 236. Feb. 1906.

Fire Blight of Pear and Apple

What Is Fire Blight?

Fire Blight is the most serious of all the diseases which attack the pear and apple. It is a contagious disease of bacterial origin which, under proper conditions, may attack any part of the tree. Besides the pear and apple, the quince, wild crab-apple, hawthorns, mountain ash, serviceberry and some other pomaceous trees are subject to attacks of this disease.

Cause of the Disease.

Fire Blight is caused by a minute organism belonging to the group of bacteria and known technically as *Bacillus amylovorus*. It is a rod-shaped, motile germ which divides very rapidly by simple fission and is found in immense numbers in the diseased tissue. The germs are so minute that they measure only about 1 / 25000 of an inch in length and are visible only under the highest magnification of the compound microscope. (Fig. 1)

Proofs of the Bacterial Nature of the Disease.

Myriads of germs are present in all freshly blighted portions of the tree and in the sticky ooze from exuding cankers. Pure cultures of the organism may be obtained from diseased tissue and cultivated for generation after generation on suitable culture media. Healthy tissue inoculated with germs from such a pure culture will become characteristically diseased. The germs are found in abundance in the tissues so inoculated and when grown in pure culture and compared with germs from naturally infected tissue, and with those used to produce the artificial infection, are found to be identical. (Fig. 2)

Part of the Tree Affected.

The germs live almost entirely in the sappy portion of the bark, though in some vigorous-growing varieties of pears the germs have been known to invade the sap wood to a limited extent. When in-

(Fig. 1,) Bacteria of Fire Blight direct from canker. Greatly enlarged.

(Fig. 2) Canker on pear produced by inoculation with organism from apple.

(Fig. 4) Typical canker on apple.

oculated into the growing tips of branches, into the blossom, or the fruit, the germs are found generally throughout the tissues.

Distribution.

Fire Blight occurs in more or less severity in nearly all parts of the United States where pears and apples are grown. It was first reported in the Hudson River Valley, N. Y., about 1792 and was doubtless indigenous in the eastern United States. The disease has gradually spread westward as the country became settled and according to Waite became known in California about 1895-1897. According to the same author it has been known in British Columbia for almost the same period. It is probable that the disease has progressed westward along two rather distinct routes—one north into Idaho, Washington and British Columbia, the other south into California.

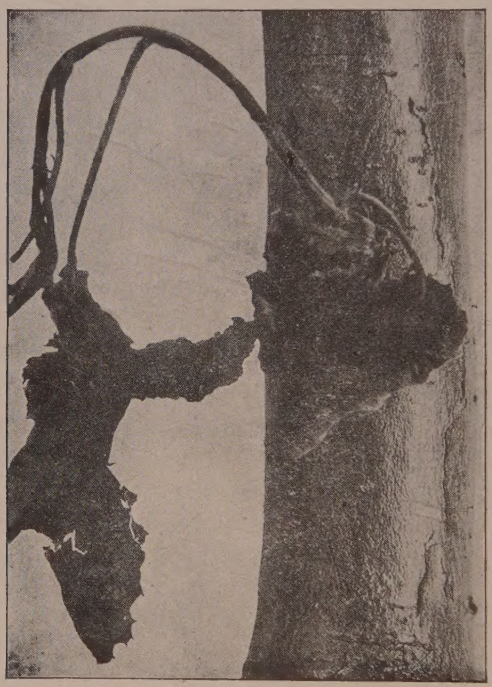
In Oregon Fire Blight has appeared in two general localities—one in the southwestern part of the state, including the Rogue River Valley, the other in the northeastern part. The former region has doubtless become infested by the spread of the disease north from California, while the eastern part of the state has been infected through Idaho or Washington along the northern route.

Life Cycle of the Blight Organism.

Beginning in the spring the first apparent damage produced by the disease in an infected orchard is the blighting of the blossoms. Infection is brought about by insects, principally bees, which have visited a case of hold-over blight and become covered with the organisms contained in the sticky exudation, inoculating the flowers in their search for nectar. The organisms divide and multiply in the nectar and are able to enter the living tissues through the unprotected nectaries. Having entered the tissues they quickly blight the blossoms, pass down the blossom-stem and into the fruit spur, killing the tissues and cutting off the leaves from water supply causing them to shrivel and dry, thus producing "fruit spur blight." The latter occurs several weeks after blossom infection. In very serious cases nearly all the fruit spurs may be blighted in this way and the trees set no fruit. Usually the germs die out and do not grow into the twig or branch on which the spur occurs but occasionally the germs may continue into the bark of the branch at the

base of the fruit spur and form a typical canker. Fruit spurs on the larger branches are a fruitful source of body infection and many cases of blight canker originate in this way.

Blight cankers may also originate through infection taking place at the tip of young actively growing branches, particularly if these be water sprouts on the larger branches, or trunks or through infection gaining a foothold in wounds of any kind. Such cankers on the larger limbs and trunk may retain active germs over the



(Fig. 3) Canker resulting from infection in small water sprout.

dormant season and form the so-called "hold-over" cankers which doubtless afford the only source of infection for the blossoms in the spring.

Appearance of the Disease.

The name "Fire Blight" is given to this disease because of the characteristic appearance of pear foliage on twigs or branches which have been killed by the blight organisms. The leaves turn black

as though scorched by fire and frequently remain on the tree during the following winter. It should be noted that this color of the foliage is characteristic of the pear when it has been killed during the growing season. If a grower not familiar with the pear blight desires to know how the "twig blight" looks let him girdle a twig in mid-summer and watch the results. The foliage of the fruit spurs, killed by the blight, has much the same appearance as that of the twigs. On the apple the foliage of twig and fruit spur blight turns brown and dry.

The cankers are also quite characteristic but are very variable in appearance, dependent on the age of the branch attacked and upon the condition of the tree. (Fig. 4) The disease progresses most rapidly in the fleshy outer layer of the bark and at first produces a watery appearance in the affected area. Later the tissues of the bark are more or less broken down and the cankers become dark in color and slightly sunken and are filled with a gummy substance which in active cankers exudes. This exudate is at first sticky and contains myriads of live germs. It is attractive to insects which visit such cankers in great abundance and become covered with the organisms. If after becoming infected in this way they visit the blossoms for nectar they inoculate the blossom with the germs which find an easy access to the tissues of the blossom through the nectaries.

Besides the blight cankers found on the limbs and trunks one frequently finds in some varieties of pears and Spitzenberg apples a larger canker at the surface of the ground extending up on the trunk for some distance and down the large roots. This condition is called "collar rot," and may result from a blight canker appearing on the trunk and running down into the collar, or may result from infection taking place through twig blight running down water sprouts which come off at or near the surface of the ground. Wounds made by borers or gnawing animals may furnish the point of infection.

A root rot may be caused by the organisms gaining entrance to the bark of roots through infection in the tips of water sprouts which come off some distance from the tree. This condition is common in some varieties of pears.

A pear tree when badly cankered is easily recognized at a distance in the early autumn by the general reddish cast to the foliage. When the foliage of only a part of the tree is reddish it indicates that a large canker has wholly or partly girdled one of the large

(Fig. 5) An active blight canker at the base of Spitzenberg apple tree. Note the exuding sap. Such cankers result in "collar rot" and usually are fatal to the tree. (Original)

branches. If the foliage of the whole tree is equally affected we should look for a canker at the collar or roots. It should be mentioned, however, that any disorder of the root system, whether due to pear blight or some fungus or physiological disease will have a similar effect on the foliage. Whetzel has pointed out that when the apple is badly cankered, either on the larger limbs or trunk the foliage is pale green or grey, more or less dwarfed and curled, a condition which has been called by growers "mouse ear."

Modes of Infection.

The pear and apple tree are covered by a protective layer of tissue, the cuticle, through which the blight organisms cannot enter, except the nectaries and stigmas in the blossoms and actively growing tips of branches. Therefore except in cases of blossom infection and some cases of twig blight the germs can enter only through wounds which expose the sappy portion of the bark. Wounds may be caused in various ways—punctures of insects, birds (sap suckers), gnawing of animals, barking or otherwise wounding by careless farm hands in cultivation, pruning or picking. Germs may also enter through growth cracks.

Method of Spreading the Disease.

The Fire Blight germs are naturally disseminated chiefly by insects at blossoming time as described above. Insects may also carry the germs to wounds on the branches or trunk. It is probable that a portion of the infection of the twigs resulting in twig blight may be brought about by insect punctures. The feet of birds may become infected with blight germs and the disease thus carried long distances. Sap suckers may "tap" an active canker and carry the germs to uninfected trees. Typical cases of body blight have been traced by Waite to this sort of infection. Rain may wash the germs from the ooze of active cankers to wounds, insect punctures or growth cracks lower down on the branches or trunk of the same tree.

One of the most fruitful sources of infection has been by the pruning shears or saw. In pruning, if an active canker is cut into, the tools become infected and serve as inoculating instruments to spread the disease throughout the orchard.

Infection may spread very rapidly from one district to another

along highways where seedling apples and pears are allowed to grow unmolested. Seedling trees springing from fruit cores thrown from car windows make of the great overland railroads a natural and easy road over which Fire Blight may travel for long distances through unsettled regions. This is one of the possible ways that the most favored valleys, naturally isolated by mountain barriers, may become infected.

Conditions Favoring the Disease.

The disease is more prevalent in orchards which are rapidly growing and in a succulent condition due to naturally rich soil, abundant cultivation or application of nitrogenous fertilizers. Heavy winter pruning has a tendency to stimulate rapid and succulent growth and renders the tree more subject to the attacks of the blight. Irrigation should be reduced to the minimum in infested orchards.

Method of Control.

The only method known of controlling Fire Blight is to cut out all cases of hold-over cankers wherever they appear. Spraying with fungicides is of only supplementary value and the various "blight cures" are worse than useless and it is a waste of time and money to apply them.

Experience has shown that it is of little permanent value to attempt to cut out the fruit spur and twig blight as they appear. Unless these forms of the disease extend into the branches on which they occur and a canker is formed the disease usually becomes naturally limited and the germs gradually die, due to drying out of the canker so that at the beginning of the dormant season very few such cases show live germs present.

The efforts of the grower should be directed to cutting out all cases of blight canker and body canker during the fall, winter and early spring when the cankers have become more or less limited in their growth and are not actively spreading.

Summer cutting intelligently applied is frequently of great value particularly where there is only a little blight. In the autumn before the leaves fall is a good time to do the cutting as all cases of twig blight are easily observed and the condition of the foliage as already described, offers a convenient method of determining the

presence of cases of root rot or collar rot and obscure cases of blight canker on body or lower limbs.

Every orchardist in an infected district should examine all pear and apple trees at the time suggested and cut out all diseased portions. The trees should be particularly examined for cases of the collar rot. It is this form of the disease that causes many trees to be killed outright.

In infected regions it has been found practical by the most suc-

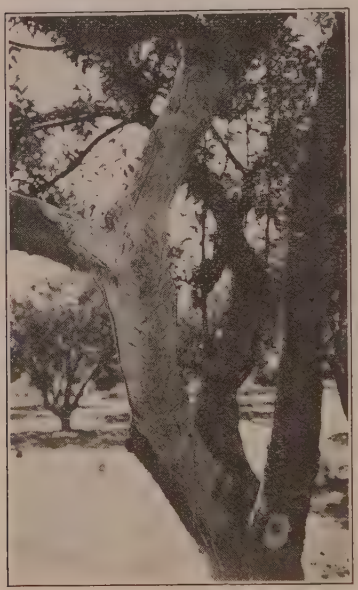
(Fig. 6) An attempt to save a tree affected with the Fire Blight form of "collar rot." The diseased bark has been cut away. (Original)

cessful owners of commercial orchards to keep one or more men in the orchard during the summer and fall whose sole duty it is to locate and cut out all cases of blight canker as soon as they appear. This work of inspection and eradication can very profitably be carried on during the summer and early autumn but the best time to do the work is in the late fall, winter and early spring, for reasons already given. If an orchard is gone over carefully by trained inspectors two or three times and all cases of this so-called "hold-

over" blight be cut there will be no source of infection in the spring and consequently no blossom blight.

A final and very thorough inspection of orchards should be made in the early spring before the blossoms open so as to detect and remove any cankers which may have been missed in the earlier inspections. This is one of the most important inspections that should be given.

The matter of eradication is complicated, however, by the fact that insects may carry the disease considerable distances, and even though one grower may eliminate hold-over blight from his own orchard he may lose a large part of his crop by blossom blight and have his orchard re-infested by insects carrying the blight germs from hold-over cankers in a less careful neighbor's orchard. Apple and pear trees in town and city lots are seldom cared for in an up-to-date manner and in infected fruit districts become a very serious menace to commercial orchards in the vicinity.



(Fig. 7) An extensive canker on apple. The bark has been cut away and the wound painted with white paint. (Original)

How to Cut Out the Disease.

Where cankers occur on small limbs or are so extensive as to nearly girdle the limbs on which they occur the whole limb or branch should be removed. In cutting off such a limb it is important that one get well below the area of infection. For safety, the cut should be made at least a foot below apparent infection since in actively growing cankers the discoloration of the bark is frequently so slight as to be easily overlooked.

Where cankers occur on the larger limbs and trunks, if not too extensive, the limb or tree may frequently be saved by carefully shaving off the diseased bark of the cankers to the sapwood. Here again one should cut well beyond the point of infection, especially above and below

the canker since the germs spread most rapidly up and down from the point of infection.

In the pear at the beginning of the dormant period the diseased bark of hold-over cankers has a characteristic reddish tinge and with a little experience one can tell how far infection has occurred. In actively growing cankers in spring and summer it is frequently very difficult to determine the extent of the infection vertically as there may be very little discoloration. In apples it is usually more difficult to determine the extent of infection than in pears.

In cutting into the cankers it is convenient to use a gouge such as is used by carpenters. This is especially valuable where cankers occur in crotches of limbs. It has the special advantage of making a clean cut that can be easily sterilized.

Sanitary Measures.

In cutting out the cankers it is necessary that the tools be kept moist with some good disinfectant. If this is not done when cutting out an active canker each cut will reinoculate the germs into the bark at the edges of the canker and the labor may thus be use less.

(Fig. 8) A canker cut out to healthy bark ready to be painted.

Corrosive sublimate in a solution of one part to one thousand of water has been found to be the most satisfactory disinfectant. It is convenient to buy this from the druggist in tablet form. The solution is a violent poison and should be so marked and carefully guarded. It should be kept in a glass bottle as it will corrode metal containers. It is convenient to carry a sponge or cloth which is kept moist with the disinfectant and used to wipe off the tools after each cut. After the process of cutting out a canker is completed sufficient time should be allowed for the canker to dry out thoroughly when the surface should be carefully disinfected, and

then painted over with white lead paint. The wound should be kept painted with a coat of paint till healed over by the formation of callus.

When cutting out twig blight or when pruning out badly diseased limbs the same precaution should be taken and the pruning tools sterilized after each cut. All pruned branches should be immediately taken from the orchard and burned. This is especially important if cutting is done in summer.

In infested districts sterilization of all tools after each cut during regular summer or winter pruning should be made a regular practice since it might happen that a hold-over canker be cut into and the tools become infected and the disease thus spread throughout an orchard.

Supplementary Methods of Control.

Spraying with lime-sulfur solution—winter strength—after the final spring inspection and just before the buds open has been sug-

(Fig. 9) The wrong way to cut out water sprouts. This Spitzenberg tree was in the same orchard as the tree shown in Fig 5. (Original)

gested by Waite as an aid in preventing the spread of Fire Blight. An application at that time would cover over any cases of hold-over canker and serve to disinfect the sticky ooze as well as render it less attractive to insects.

Waite's method of pruning the pear in vase form makes the best type of tree in which to fight the pear blight. Fruit spurs should be kept off the larger branches and under no condition should water sprouts be allowed to form on the trunk or from the roots. These when occurring on branches or trunks should be cut off flush with the wood. A convenient tool for this purpose is the carpenter's gouge. Should water sprouts spring up from the roots they should be cut off below the ground.

It is a good practice in infested districts to remove all "weed" trees of the Pome family which occur along roadsides or in the vicinity of commercial orchards as such trees are veritable nurseries for the blight.

Practibility of Controling Fire Blight.

Fire Blight has proven so wide-spread and destructive and has ruined so many pear and apple orchards in various sections of the country that many persons have the erroneous idea that it can not profitably be controlled. In recent years it has been proven conclusively that where all the pear and apple growers in an infested district work together, the control of Fire Blight is not only practicable but ceases to be a serious problem. The difficulty comes in getting all the growers to inspect their orchards and cut out the disease faithfully each year. There are always disinterested persons, and in Oregon at least there are still some general farmers scattered through the fruit districts who own family orchards. It is difficult to make such men realize their responsibility in regard to Fire Blight. The town and city lot orchardist is in the same class. Efficient county fruit inspection can do a great deal toward persuading, and if necessary forcing, such persons to either keep the disease under control in their orchards or cut down the infested trees. Public sentiment must be aroused before the County Fruit Inspector can do efficient work. The greatest good comes in educating the people concerned, first to a realization of the danger of Fire Blight and then to the methods by which the disease may be kept under control.

The pear growing districts which have solved the problem of Fire Blight are few in number. Among these districts the Rogue River Valley in Oregon has been notably successful in applying Prof. Waite's method of control. This work has been under the immedi-

ate direction of Mr. P. J. O'Gara, Assistant Pathologist in the Department of Agriculture. Through a system of county fruit inspection coupled with efficient education in regard to Fire Blight, public sentiment has been aroused and the people work together in controlling the disease.

It should be emphasized however that the Fire Blight is a State and not a local problem. The disease is spreading and in time will without doubt occur in all parts of the state. It depends on the people whether or not it will be held under control. Complete eradication is not to be expected.

NOTE.—It is proposed to issue from time to time circular bulletins dealing with crop pest problems. This circular is the first of the series.

The Department of Entomology and Plant Pathology will be glad to answer inquiries relating to Insect Pests or Plant Diseases at any time. Always include with your inquiries as full a description of the trouble as possible and send specimens for examination.

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